

REMARKS

Claims 24, 25, 56 and 57 have been amended and claims 59-70 have been added. Claims 24, 45 and 52-70 remain pending in the instant application. Reconsideration of the application is requested in view of the amendments and the remarks to follow.

The amendments to the specification and drawing correct minor informalities noted during review and/or provide provenance data that has become available. No new matter is added by the amendments to the specification or drawing.

The Examiner's approval of the changes to Fig. 3, as shown on the enclosed marked-up-in-red copy thereof, is requested. Revised formal drawing has been sent to the attention of the Chief Draftsman under separate cover.

Claims 24, 45, 56 and 57 stand rejected under 35 U.S.C. §112, second paragraph. Claims 24, 45, 56 and 57 have been amended in accordance with the concerns noted in the Office Action, however, these amendments do not alter the scope of the claims.

Claims 45 and 55-58 stand rejected under 35 U.S.C. §102(a) as being anticipated by Kawamura et al., JP 8139056. Claims 24 and 52-54 stand rejected under 35 U.S.C. §102(e) as being anticipated by Cabral et al., U.S. Patent No. 5,828,131. Claims 24 and 52-54 stand rejected under 35 U.S.C. §103(a) as being obvious over Cabral et al., U.S. Patent No. 5,828,131. Applicants disagree and request reconsideration.

The Examiner states (p. 3, item 1, oddly, the entire rejection, including spelling and punctuation errors but substituting Fig. 5 for Fig. 2, is repeated at p. 4, item 2) that "Kawamura [sic] et al [sic] teaches [sic] the claimed method of forming a refractory metal silicide comprising steps: [sic] providing a compressive stress inducing material 11, silicon oxide, fig [sic] 2A) over a first side of a substrate (1); forming a refractory metal silicide (6, 7, Titanium silicide C49, fig [sic] 2B) over the compressive stress inducing material (11), the metal silicide comprising a first crystalline phase (C49); after forming the refractory metal silicide, annealing the refractory metal silicide comprising the first crystalline phase to form a refractory metal silicide of a second crystal [sic] phase (6, 7, titanium silicide C54, fig [sic] 2C)." The Examiner is mistaken on multiple grounds, as is explained below in more detail.

First, the §102 rejection of claims 45 and 55-58 is believed to be in error. Specifically, the PTO and Federal Circuit provide that §102 anticipation requires that each and every element of the claimed invention be disclosed in a single prior art reference. *In re Spada*, 911 F.2d 705, 15 USPQ2d 1655 (Fed. Cir. 1990). The corollary of this rule is that the absence from a cited §102 reference of any claimed element negates the anticipation. *Kloster Speedsteel AB, et al. v. Crucible, Inc., et al.*, 793 F.2d 1565, 230 USPQ 81 (Fed. Cir. 1986).

Accordingly, if Applicants can demonstrate that the Kawamura et al. reference does not disclose any one claimed element with respect to claims 45 and 55-58, the §102 rejections must be withdrawn, and a subsequent

non-final action made with a different rejection in the event that the Examiner still finds such claims to be not allowable.

Applicants also note the requirements of MPEP §2131, which states that "TO ANTICIPATE A CLAIM, THE REFERENCE MUST TEACH EVERY ELEMENT OF THE CLAIM." This MPEP section further states that "'A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.' *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). 'The identical invention must be shown in as complete detail as is contained in the ... claim.' *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an ipsissimis verbis test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990)."

First, the layer 11 of Fig. 2 relied on by the Examiner is not a compressive-stress inducing layer, as is erroneously alleged by the Examiner. Those of ordinary skill in the relevant arts will immediately note that the layer 11 in Fig. 2B results in expansion, or dilatation, and not compression, of the layers 6 and 7, as is evident from the convex shape of the substrate 1 incorporating such layer. The layers 6 and 7 are only put into compression by removal of the layer 11. The layer 11 thus is not a compressive-stress inducing layer, as is positively recited in claim 45. Accordingly, the cited

portion of Kawamura et al. with respect to Fig. 2 does not provide the claimed elements as recited in claim 45, and cannot anticipate claim 45.

Fig. 5 illustrates an arrangement whereby a Ti layer 9 and a TiN layer 10 are formed on a back surface of a silicon substrate 1. The layers 9 and 10 are chosen (p. 15 of translation) to have a much higher thermal coefficient of expansion than the silicon substrate 1. As a result, the back surface of the substrate 1 is put into dilatation, in turn causing the front surface to be put into compression. This causes the layers 6 and 7 to be put into compression. Accordingly, the layers 9 and 10 cause both dilatation and compression, but only in conjunction with the material comprising the substrate 1. The layers 9 and 10 thus are not compressive-stress inducing layers, as is positively recited in claim 45. Accordingly, the cited portion of Kawamura et al. with respect to Fig. 2 does not provide the claimed elements as recited in claim 45, and cannot anticipate claim 45.

Second, Kawamura et al. fail to teach or disclose "forming a refractory metal silicide over the compressive stress inducing material layer", as recited in claim 45. Accordingly, the reference fails to provide "the identical invention" as recited in the claim and as is required in order to find anticipation.

Third, Applicants note the requirements of MPEP §2121.01, entitled "Use of Prior Art in Rejections Where Operability Is In Question". This MPEP section states that "In determining that quantum of prior art disclosure which is necessary to declare an applicant's invention 'not novel' or 'anticipated'

within section 102, the stated test is whether a reference contains an 'enabling disclosure'... ." *In re Hoeksema*, 399 F.2d 269, 158 USPQ 596 (CCPA 1968). A reference contains an "enabling disclosure" if the public was in possession of the claimed invention before the date of invention.

Claim 45 recites "A method of forming a refractory metal silicide comprising: forming a compressive stress inducing material layer over a first side of a substrate; forming a refractory metal silicide over the compressive stress inducing material layer, the refractory metal silicide comprising a first crystalline phase; and after forming the refractory metal silicide comprising a first crystalline phase, annealing the refractory metal comprising a first crystalline phase to form a refractory metal silicide of a second crystalline phase", which is not taught or disclosed by Kawamura et al. Additionally, Kawamura et al. fail to enable the claimed invention, as is required in order to make a valid finding of anticipation.

Fourth, and more specifically, the interpretation that the Examiner appears to be placing on the teachings of Kawamura et al. is that when the substrate is in the position illustrated by Kawamura et al., the refractory metal silicide layer 6, 7 (Figs. 1B-1D, explanatory text on pp. 5, 6 and 10-12 of translation; 2B and 2C, p. 8, explanatory text at pp. 12, 13) or 10 (Figs. 5B and C, p. 9) is literally "over" the compression-inducing layer 8 (Figs. 1C, 1D; p. 11 of translation) or 11 (Figs. 2A and 2B; compression is induced by removing the layer 11 from the backside, followed by thermal treatment, see pp. 12, 13 of translation). However, this interpretation depends on the

orientation of the substrate, while the invention as recited in Applicant's claim 45 does not depend on such a strained interpretation of what Kawamura et al. teach.

Fifth, and in other words, claim 45 recites that the stress-inducing layer is formed on a first side of the substrate, while the refractory metal silicide is formed over the stress-inducing layer. This language comprehends forming the refractory metal silicide on the stress-inducing layer, even, for example, when the commonly-employed "sputter-up" approach is employed. As is well and widely known to those of ordinary skill in the relevant arts, "sputter-up" refers to a technique whereby the substrate is inverted above the sputtering target in order that any debris generated during the sputtering process cannot fall on the surface of the substrate that is being treated.

Sixth, and put another way, the interpretation that the Examiner is giving to the term "over" gives the term "over" a meaning repugnant to the ordinary meaning of the term as it is employed herein. More specifically, Applicants clearly are using the term "over" in the sense found, for example, in Merriam-Webster's Collegiate Dictionary, Tenth Ed. (Merriam Webster, Inc., Springfield MA, principal copyright 1993) at p. 827, "²**over prep ... 4 a** - used as a function word to indicate position upon" (copy enclosed herewith). This can be understood by using the specification (see, e.g., p. 7, lines 22 and 23) to interpret the language of the claims (see MPEP §2111, entitled "Claim Interpretation; Broadest Reasonable Interpretation").

For at least these six reasons, the rejection of claim 45 and claims dependent therefrom is defective and should be withdrawn, and claim 45 and claims dependent therefrom should be allowed.

Claim 24 recites "A method of forming a refractory metal silicide layer comprising: forming a titanium metal layer over a silicon containing substrate; providing stress inducing atoms into the titanium metal layer, the compressive stress inducing atoms being larger than silicon atoms; after the providing, first annealing the titanium metal layer containing the compressive stress inducing atoms to form a titanium silicide layer substantially of a first crystalline phase; and second annealing the titanium silicide layer substantially of the first crystalline phase under conditions effective to transform said titanium silicide layer to a more dense layer substantially of a second crystalline phase", which is not taught, disclosed, suggested or motivated by Cabral et al.

The Examiner states (pp. 4 and 5) that Cabral et al. disclose a method including "providing compressive stress inducing atoms ... larger than silicon atoms (e.g. W in Ti-alloy, col. 11-12)." The Examiner is mistaken.

Cabral et al. are silent with respect to providing compressive stress inducing atoms. In fact, neither the word "compressive" nor any equivalent thereto appear anywhere in Cabral et al., and the Examiner has failed to even attempt to show where such might be found in Cabral et al.

Cabral et al. teach that W may be alloyed with titanium (col. 11, lines 25-30). Alloying metals is not arbitrarily interchangeable with Applicant's

positive recitation of providing compressive stress inducing atoms, as recited in claim 24.

The Examiner states (p. 5) that, with respect to claims 53 and 54, Cabral et al. teach that Ge may be incorporated into the titanium metal layer, referencing col. 10, lines 15-29 and col. 3, lines 63 and 64.

Claims 53 and 54 depend from claim 24 and thus incorporate by reference the recitation of the invention presented in claim 24 (35 U.S.C. §112, 4TH ¶). Claim 24 explicitly recites that the compressive stress inducing atoms are larger than silicon atoms. The laundry list of elements taken from cols. II-VI of the periodic table that is presented at col. 3, lines 63 and 64 includes C, B, N etc. As a result, this passage does not suggest or motivate any atom that is explicitly larger than a silicon atom.

Further, no motivation is provided in the cited passage for the inclusion of any of these elements. As such, this passage fails to teach, disclose, suggest or motivate any "compressive stress inducing atom" as recited in Applicant's claims. Similarly, the passage appearing at col. 10, lines 6-29 recites that a relatively large proportion of the periodic table "may" be present but again provides no motivation for inclusion of any of them, beyond noting (without explanation) that Group VII elements "are to be avoided, but if present, should be present in levels well below the atomic percent of the refractory metal."

Simply stating a conclusion that "it would have been obvious" to combine teachings from references or to modify or augment teachings from

a reference does not meet the standards for a rejection under 35 U.S.C. §103(a) as set forth in The Manual of Patent Examination Procedure at §706.02(j) entitled "Contents of a 35 U.S.C. 103 Rejection." This MPEP section states that three basic criteria must be met in order to establish a prima facie case of obviousness.

The first of these is that there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine reference teachings. The Office Action fails to show that the subject matter of claims 24 and 52-54 is suggested or motivated by the teachings of the reference(s).

The second requirement of MPEP §706.02(j) is that there must be a reasonable expectation of success. The third requirement is that the prior art reference (or references when combined) must teach or suggest all of the claim limitations. Since the Cabral et al. reference is silent with respect to providing compressive stress inducing atoms into the titanium metal layer, modifying their teachings cannot possibly provide the invention as recited in any of Applicant's claims. As a result, there cannot possibly be a reasonable expectation of success from modifying the teachings of the reference.

The

Accordingly, Cabral et al. (i) fail to provide the elements of the invention as recited in claim 24, as is required for a finding of either anticipation or unpatentability, (ii) fail to enable the invention as recited in claim 24, as is additionally required for a finding of anticipation, (iii) fails to

motivate or suggest the claimed invention and (iv) fails to provide any of the three elements of the test for unpatentability as set forth in the MPEP.

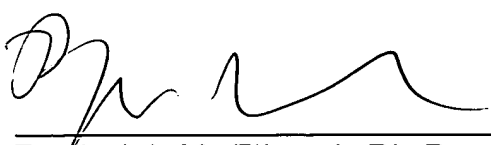
As such, it is inconceivable that Cabral et al. could anticipate the invention as recited in claim 24 or claims dependent therefrom. Additionally, it is inconceivable that Cabral et al. could render the invention as recited in any of these claims unpatentable. For at least these reasons, the rejection of claim 24 and claims dependent therefrom should be withdrawn, and claim 24 and claims dependent therefrom should be allowed.

New claims 59-70 are supported at least by text appearing at p. 7, line 5, through p. 17, line 3, of the application as originally filed. No new matter is added by new claims 59-70. New claims 59-70 distinguish over the art of record and are allowable.

In summary, Applicants respectfully assert that the pending claims are in condition for allowance. Action to that effect is earnestly sought. If, however the Examiner's next action is anything other than a Notice of Allowance, the Examiner is requested to call the undersigned to schedule a telephonic interview. The undersigned is available during normal business hours, Pacific Coast Time.

Respectfully submitted,

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Version with markings to show changes made

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. 09/233/377
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Inventor Gurtej S. Sandhu et al.
Assignee Micron Technology, Inc.
Group Art Unit 2813
Examiner T. Pham
Attorney's Docket No. MI22-1114
Title: Method of Forming a Refractory Metal Silicide (as Amended)

37 CFR §1.121(b)(1)(iii) AND 37 CFR §1.121(c)(1)(ii)
FILING REQUIREMENTS TO ACCOMPANY RESPONSE TO
DECEMBER 19, 2001 FINAL OFFICE ACTION

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Deletions are bracketed, additions are underlined.

In The Specification

The text inserted at p.1, prior to the Technical Field section, by the preliminary amendment dated January 18, 1999, has been amended as shown below:

This patent resulted from a divisional application of U.S. Patent Application Serial No. 08/748,997, filed November 14, 1996, entitled "Method Of Forming A Crystalline Phase Material", naming Gurtej S. Sandhu and Sujit Sharan as inventors, and which is now U.S. Patent No. 5,997,634, the disclosure of which is incorporated by reference.

The paragraph extending from p. 14, line 3, to p. 14, line 13, has been amended as shown below:

Another alternate embodiment is described with reference to Figs. 10-12 whereby the stress inducing layer is provided over or outwardly of, and thereby operatively adjacent, the titanium layer prior to its initial transformation to the first C49 crystalline phase. Fig. 10 illustrates a semiconductor wafer fragment 50 comprised of a bulk monocrystalline silicon substrate 52 and an overlying insulating layer 54, such as SiO₂. A polysilicon layer 56 is provided outwardly of layer 54, with a refractory metal layer 58, such as titanium, provided outwardly of polysilicon layer 56. A compressive stress inducing layer 60 is provided over and on titanium layer 58 and preferably has a thickness equal to or greater than the combined thickness of layers 56 and 58.

In the Drawing

Fig. 3 has been amended as shown on the marked-up-in-red copy of Fig. 3 enclosed herewith.

In the Claims

24. (Thrice amended) A method of forming a refractory metal silicide layer comprising:

forming a titanium metal layer over a silicon containing substrate;
providing compressive stress inducing atoms into the titanium metal layer, the compressive stress inducing atoms being larger than silicon atoms;
after the providing, first annealing the titanium metal layer containing the compressive stress inducing atoms to form a titanium silicide layer substantially of a first crystalline phase; and

second annealing the titanium silicide layer substantially of the first crystalline phase under conditions effective to transform said titanium [metal] silicide layer to a more dense layer substantially of a second crystalline phase.

45. (Thrice amended) A method of forming a refractory metal silicide comprising:

forming a compressive stress inducing material layer over a first side of a substrate;

forming a refractory metal silicide over the compressive stress inducing material layer, the refractory metal silicide comprising a first crystalline phase; and

after forming the refractory metal silicide comprising a first crystalline phase, annealing the refractory metal comprising a first crystalline phase to form a refractory metal silicide of a second crystalline phase.

53. (Amended) The method of [Claims] Claim 24, where the compressive stress inducing atoms comprise germanium atoms.

56. (Amended) The method of [Claims] Claim 45, where the compressive stress inducing material layer comprises silicon oxide or silicon nitride.

57. (Amended) The method of Claim 45, where the refractory metal silicide [layer] comprises titanium silicide.

New claims 59-70 have been added.

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